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A BURNABLE [RECORDABLE] OPTICAL RECORDING MEDIA FILM LAYER AND MATCHING MATERIALS

[Ke lun shi guang ji lu mei ti mo ceng ji qi pi pei cai liao]

Wen-tai Hsu et al.

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INVENTORS	(72):	Wen-tai Hsu et al.
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Claims /1*

1. A burnable optical recording media film layer of full optical region, high density, high resolution, high speed and high compatibility, which at least is composed of:

a substrate;

a transparent layer, which is formed on said substrate;

a reflecting layer, which is formed on said transparent layer, wherein, said transparent layer matches with said reflecting layer in thickness and the material, and when they are illuminated by a recording light of any wavelength within the range of the visible light wavelength and heated, they react to form an alloy/compound, and a semi-transparent reflecting zone is formed in the reaction range, and as the recording spot of the recording media, said semi-transparent reflecting zone has an optical signal contrast modulating mechanism; and

a dependable [sic; protective] layer, which is formed on said reflecting layer.

2. A burnable optical recording media film layer of full optical region, high density, high resolution, high speed and high compatibility as described in Claim 1, wherein said optical signal contrast modulating mechanism can be: When the write light source is any wavelength within the range of the visible light wavelength, said semi-transparent reflecting zone produced at least contains more than one of the results of signal modulation:

(1) said semi-transparent reflecting zone, due to the alloy/compound effect, changes the optical constants (n & k), thus changing the light mirror intensity;

(2) said semi-transparent reflecting zone reduces the thickness of said valid transparent layer, so as to change the difference in optic path between the entrance light and the reflected light, causing deviation of constructive interference or destructive interference;

* [Numbers in right margin indicate pagination of the original text.]

(3) said semi-transparent reflecting zone, due to the alloy/compound effect, changes the angle of the polarized light, thus changing the intensity of the signal read through the polarized light.

3. A burnable optical recording media film layer of full optical region, high density, high resolution, high speed and high compatibility as described in Claim 1, wherein said substrate is glass or polycarbonate.

4. A burnable optical recording media film layer of full optical region, high density, high resolution, high speed and high compatibility as described in Claim 1, wherein the thickness of said transparent layer ranges between 5-500 nm, and it is made of a material selected from silicon, germanium, gallium /2
phosphide, indium phosphide, gallium arsenide, indium arsenide, zinc antimonide, titanium oxide, antimony tin oxide and alloys or chemical compounds composed of the materials listed above.

5. A burnable optical recording media film layer of full optical region, high density, high resolution, high speed and high compatibility as described in Claim 1, wherein the thickness of said transparent layer ranges between 1-500 nm, and it is made of a material selected from silicon, germanium, gallium phosphide, indium phosphide, gallium arsenide, indium arsenide, zinc antimonide, titanium oxide, antimony tin oxide and alloys or chemical compounds composed of the materials listed above.

6. A burnable optical recording media film layer of full optical region, high density, high resolution, high speed and high compatibility as described in Claim 1,wherein it further includes a heat dissipation layer formed in between said substrate and the transparent layer or between said reflecting layer and said dependable layer.

7. A burnable optical recording media film layer of full optical region, high density, high resolution, high speed and high compatibility as described in Claim 1, wherein the read signal modulation mode of said optical recording media is performed by adjusting the thickness of the transparent layer:

when the thickness exceeds a specific thickness or lower than a specific thickness, the read signal of said optical recording media can be in two modulation modes, which are the modulation mode of the pre-recording high reflection intensity/post-recording low reflection intensity, or the pre-recording low reflection intensity/post-recording high reflection intensity.

8. A burnable optical recording media film layer of full optical region, high density, high resolution, high speed and high compatibility, which at least is composed of:

a substrate;

a transparent layer, which is formed on said substrate;

a reflecting layer, which is formed on said transparent layer, wherein, said transparent layer matches with said reflecting layer in thickness and the material, and when it is illuminated and heated by a recording light of any wavelength within the range of the visible light wavelength, an reaction occurs and an alloy/compound is formed, and a semi-transparent reflecting zone is formed in the reaction range, and as the recording spot of the recording media, said semi-transparent reflecting zone has the optical signal contrast modulating mechanism, at least contains more than one of the results of signal modulation:

(1) said semi-transparent reflecting zone, due to the alloy/compound effect, changes the optical /3
constants (n & k), thus changing the light mirror intensity;

(2) said semi-transparent reflecting zone reduces the thickness of said valid transparent layer, so as to change the difference in optic path between the entrance light and the reflected light, causing deviation of constructive interference or destructive interference;

(3) said semi-transparent reflecting zone, due to the alloy/compound effect, changes the angle of the polarized light, thus changing the intensity of the signal read through the polarized light; and a dependable layer, which is formed on said reflecting layer.

9. A method as described in Claim 8, wherein said substrate is glass or polycarbonate.

10. A method as described in Claim 8, wherein the thickness of said transparent layer ranges between 5-500 nm, and it is made of a material selected from silicon, germanium, gallium phosphide, indium phosphide, gallium arsenide, indium arsenide, gallium antimonide, indium antimonide, indium tin oxide, tin oxide, indium oxide, zinc oxide, titanium oxide, antimony tin oxide and alloys or chemical compounds composed of the materials listed above.

11. A method as described in Claim 8, wherein the thickness of said transparent layer ranges between 1-500 nm, and it is made of a material selected from silver, aluminum, gold, platinum, copper, tin, iridium, tantalum, alloys of the metals listed above and combination of the metals listed above.

12. A method as described in Claim 8, wherein it further includes a heat dissipation layer formed in between said substrate and the transparent layer or between said reflecting layer and said dependable layer.

13. A method as described in Claim 8, wherein the read signal modulation mode of said optical recording media is performed by adjusting the thickness of the transparent layer: When the thickness exceeds a specific thickness or lower than a specific thickness, the read signal of said optical recording media, can be in two modulation modes, which are the modulation mode of the pre-recording high reflection intensity/post-recording low reflection intensity, or the pre-recording low reflection intensity/post-recording high reflection intensity.

Description /1

The present invention relates to optical recording media, particularly to a burnable optical recording media film layer of full optical region, high density, high resolution, high speed and high compatibility and matching material.

A burnable optical recording media for recording and long-term preservation. It can be applied to uses requiring long-term preservation such as electronic publication, multimedia information recording or if there is a requirement for frequent backups. In recent years, it has had a considerable media market, and is still in sustained growth.

Regular burnable optical recording media, are structurally composed of the substrate, reaction layer, reflecting layer, and protective layer. And the major part of them to record signals are the reaction layer and the reflecting layer. However, the reaction layers of existing burnable optical recording media, are mostly made of organic dyestuff. Use of the organic dyestuff as the recording material has the following disadvantages:

1. It is liable to deterioration under light illumination, and the shelf life of the product (before recording) is obviously shorter.

2. Not much potential to develop in the direction of high density.

3. The absorption wavelength is narrow, and it has to be recorded using the specific wavelength, therefore the compatibility of the applicable recording system is low.

4. Organic dyestuff needs to be made in coordination with chemicals such as organic solvents, causing environmental issues.

In the known technology, an example of optical recording media with inorganic material as the recording film layer, can be found in JP [Japanese] 06-171236, wherein aluminum or gold is used as the reflecting layer, to coordinate with the reaction layer constituted by germanium. Its reflection rate can be enhanced by up to 70%. Its tone modulation is only the upward modulation, and it is not capable of descending modulation, and its application is restricted due to incompatibility with the mode of modulation of the existing optical recording media. Another example can be found in US Patent 5, 458, 941, wherein gold/chromium, gold/cobalt or aluminum/titanium is used as the reflecting layer, and a

semiconductor material as the reflecting layer [sic; reaction layer]. The reflecting layer is placed in the entrance plane of the recording light source so as to enhance the reflection intensity, but the recording light source is of low use efficiency, and recording requires a high recording light power. Therefore the practicability of said optical recording media is hindered. Of the two optical recording media of inorganic material and optical recording media of [inorganic] dyestuff, either can meet the requirement of high density and full optical region in the future. Another example is the patent application disclosed /2
in [Japanese] 08-274809 of Japan, wherein a semiconductor material is used as the recording layer, matched with a semi-crystal semiconductor cladding (the condition of matching is that it is capable of producing a semiconductor/metal contact crystal). Because a semi-crystal semiconductor cladding (reaction layer, such as silicon) can produce crystal on the semiconductor/metal (reflecting layer, such as silicon) interface, it can cause modulation of the light reflection intensity. By relying on non-crystalline/crystalline transformation only for signal modulation, the range of signal modulation is relatively restricted, thus further restricting the compatibility of the specifications of the disc.

The purpose of the present invention is to provide a burnable optical recording media film layer of full optical region, high density, high resolution, high speed and high compatibility and matching material, and this optical recording media film layer is at least composed of a substrate, a transparent layer, and a reflecting layer; and when the transparent layer and reflecting layer of this optical recording medium film layer is illuminated by the recording light and heated, they react to form an alloy/chemical compound, and a semi-transparent reflecting zone is formed in, and this semi-transparent reflecting zone causes the following effects: (1) Reduction of the thickness of said valid transparent layer, and changes in the difference in the light path, resulting in changes in the constructive interference or destructive interference; and/or (2) Changes in the optical constants (n & k), and further changes in the light

refection intensity; and/or (3) Changes in the angle of the polarized light. And at least one of the effects mentioned above constitutes the tone modulation of the optical recording media before/after recording.

The reasons that the film layer of the burnable optical recording media of the present invention and the matching material are (1) full optical region, (2) high density, (3) high resolution, (4) high speed and (5) high compatibility, are as follow:

(1) The metals or their alloy material in the reflecting layer all have considerable reflecting strength within the range of visible wavelength, and all of them in the full optical region of visible light can produce a semi-transparent reflecting zone with the transparent layer, so as to attain an appropriate recording contrast, therefore the applicable recording light covers a large wavelength;

(2) Then in coordination with a reflecting layer of high heat conductivity, the size of the semi-transparent reflecting zone can be reduced, thus enhancing the recording density;

(3) Through fast heat dissipation of the reflecting layer of high heat conductivity, the reaction can be accelerated, thus enhancing the recording speed;

(4) There is an obvious critical energy density requirement for production of the semi-transparent reflecting zone, resulting in a distinctive peripheral boundary of the semi-transparent reflecting zone, thus producing a high resolution recording; /3

(5) The formation of the semi-transparent reflecting zone is an exothermal reaction, therefore the power required for the recording light source can be reduced appropriately, and with only a slight adjustment, the recording media is [can be made] compatible with recording media of different specifications.

The film layer of the burnable optical recording media of the present invention and the matching material have the following functions:

1. The material provided by the present invention, with a wide range of wavelength of recording light, is applicable to existing CD disc systems, or the DVD system being promoted, or the recording media system of the blue light wavelength in the future.

2. In the present invention, with an association of the alloy layer of high heat conductivity and the exothermal alloy reaction, the recording spot can be very tiny while the reaction speed is fast. It is applicable to a high density optical recording media of high speed recording.

3. The optic disc film layer system provided by the present invention can have both the same modulation specifications as the existing optical disc, or the modulation specifications different existing optical discs.

4. The inorganic material used in the present invention will not react unless it exceeds the specific light drive intensity, therefore it is less sensitive to general light illumination, the light tolerance is stable, and it is not easy for optical discs to deteriorate.

5. An inorganic material is used in the present invention, thus avoiding the issue of environmental pollution as a result of use of organic solvents.

The following is an illustration of the burnable optical recording media film layer of the present invention that are of full optical region, high density, high resolution, high speed and high compatibility and the matching material in association with the attached drawings and tables.

Figure 1A is a schematic diagram of the structure of the optical recording media film layer (with the heat dissipation layer) of the present invention.

Figure 1B is a schematic diagram of the structure of the optical recording media film layer (without the heat dissipation layer) of the present invention.

Figure 2A is a schematic diagram of the change of the structure of the optical recording media film layer (with the heat dissipation layer) of the present invention after write-in.

Figure 2B is a schematic diagram of the change of the structure of the optical recording media film layer (without the heat dissipation layer) of the present invention after write-in.

Figure 3 is the photograph from observation under an optical microscope, after a static test of Example 1.

Figure 4 is the photograph from observation under an optical microscope, after a static test of Example 2.

Figure 5 is the photograph from observation under an optical microscope, after a static test of Example 3.

Reference Materials

10 – substrate; 20 – First heat dissipation layer; 25 – Valid transparent layer; 30 – Transparent layer; 35 – Semi-transparent reflecting zone; 40 – Second heat dissipation layer; 60 – Dependable layer; 70 – Recording light.

For better and easier understanding of the above-mentioned and other purposes, characteristics, and /4 variations of the present invention, the following is a detailed description of some preferred embodiments in association with the attached drawings.

Preferred embodiments

The manufacturing procedure of the burnable optical recording media film layer of the preferred embodiment of the present invention is as follows:

Optical disc substrate → (or heat dissipation layer deposition) → transparent layer deposition → reflecting layer deposition → (or heat dissipation layer deposition) → protective layer coat.

The manufacturing procedure begins with preparation of a substrate 10, and it is required that this substrate be glass or polycarbonate. The next step is formation of the first heat dissipation layer on the substrate 10. After that, a transparent layer 30 is formed on the first heat dissipation layer 20, and the thickness of this transparent layer ranges between 5-500 nm, and it is made of a material selected from silicon, germanium, gallium phosphide, indium phosphide, gallium arsenide, indium arsenide, zinc antimonide, titanium oxide, antimony tin oxide and alloys or chemical compounds composed of the materials listed above.

Then, a reflecting layer 40 is formed on the transparent layer 30, and the thickness of said transparent layer ranges between 1-500 nm, and it is made of a material selected from silver, aluminum, gold, platinum, copper, tin, iridium, tantanlum, alloys of the metals listed above and combination of the metals listed above. The transparent layer 30 matches with the reflecting layer 40 in thickness and material, and when they are illuminated by a recording light of any wavelength within the range of the visible light wavelength and heated, they react to form an alloy/compound, and a semi-transparent reflecting zone 35 is formed in the reaction range, as is shown in Figures 2A and 2B; and as the recording spot of the recording media, this semi-transparent reflecting zone has the optical signal contrast modulating mechanism. This optical signal contrast modulation mechanism is one that, when the write light source is any wavelength within the range of the visible light wavelength, said semi-transparent reflecting zone produced at least contains more than one of the results of signal modulation:

(1) Said semi-transparent reflecting zone, due to the alloy/compound effect, changes the optical constants (n & k), thus changing the light mirror intensity;

(2) Said semi-transparent reflecting zone reduces the thickness of said valid transparent layer, so as to change the difference in optic path between the entrance light and the reflected light, causing deviation of constructive interference or destructive interference;

(3) Said semi-transparent reflecting zone, due to the alloy/compound effect, changes the angle of the polarized light, thus changing the intensity of the signal read through the polarized light.

In addition, a third [sic; second] heat dissipation layer 50 is formed on the reflecting layer 40. Finally, a protective layer 60 is formed on the second heat dissipation layer 50, and the protective layer 60 can be formed through spiral coating, and the structure is as shown in Figures 1A and 1B. Figure 1A is a schematic diagram of the structure with the heat dissipation layer, while Figure 1B is a schematic diagram of the structure without the heat dissipation layer.

The read signal modulation mode of the burnable optical recording media film layer of the preferred embodiment of the present invention can be one through regulation of the thickness of the valid transparent layer 25 of the transparent layer 30. When the thickness exceeds a specific thickness or lower than a specific thickness, the read signal of said optical recording media can be in two modulation modes, which are the modulation mode of the pre-recording high reflection intensity/post-recording low reflection intensity, or the pre-recording low reflection intensity/post-recording high reflection intensity.

<u>Example 1</u>

The structure of the test film of Example 1 is as shown in Figures 1A and 1B, wherein the substrate 10 is transparent glass, while the transparent layer 30 is silicon, which is sputtered over the substrate 10 using 300 W for 30 min. The reflecting layer 40 is gold silicon alloy, which is sputtered over the transparent layer 30, wherein gold is sputtered at 260 W, and silicon at 210 W, and the sputtering time is 30 min.

In a static test, the recording film layer is illuminated, using a laser beam constituted by a laser 780 nm in the light wavelength, DC 21 mA (for the read-in signal), plus 1-5 V impulse (for the write-in signal, and its pulse duration is 10 ns as the minimum), to test changes in its reflection intensity. The

optical system is the same as CD-ROM, and the only difference is that the diameter of the laser beam is greater than the CD system.

Figure 3 is a photograph of the static test observation using an optical microscope. Judged by the observation of the test results, in the case of DC 21 mA and AC 3V, by 10 ns of the pulse duration, the semi-transparent reflecting zone 35 (around the size of 2 ms) is still distinctively visible, and the contrast ratio between the reflection intensity of the semi-transparent reflecting zone 35 and [that] before recording (the contrast ratio = (I0 – Twr)/I0 x 100%); I0 is the reflection intensity before recording; Twr is the reflection intensity after recording) reaches 85%. When a burnable optical disc CD-R available in the market is tested under the same conditions, the size of its recording spot is around 16 mm. /6

Also the contrast ratio between the reflection intensity of the recording spot and that before recording is 50%.

Example 2

The structure of the test film of Example 2 is as shown in Figures 1A and 1B, wherein the substrate 10 is transparent glass, while the transparent layer 30 is silicon, which is sputtered over the substrate 10 at 300 W. The reflecting layer 40 is gold silicon alloy, which is sputtered over the transparent layer 30, wherein gold is sputtered at 260 W, and silicon at 210 W. The reflection layer sputtering time is 30 min.

The static test is the same as in Example 1. Figure 4 is the photograph of the static test observation using an optical microscope. Judged by the observation of the test results, the semi-transparent reflecting zone 35 during the entire pulse duration with DC 21 mA and AC over 3V has a reaction wherein the reflection intensity is enhanced, the maximum contrast ratio can be up to –45%. And the recording spot of the semi-transparent reflecting zone 35 can reach 2.0 mm at the minimum.

Example 3

The structure of the test film of Example 3 is as shown in Figures 1A and 1B, wherein the substrate 10 is transparent glass, while the transparent layer 30 is silicon, which is sputtered over the substrate 10 at 300 W (The sputtering time is respectively 5, 10, 15, 20, 25, 30, 35, and 40 min). The reflecting layer 40 is gold silicon alloy which is sputtered over the transparent layer 30, wherein gold is sputtered at 50-500 W (and the sputtering power is respectively 50, 110, 180, 240, 300, 370, 440, and 500 W), and silicon is sputtered at 210 W. There is no protective layer added on top of it. The static test is the same as in Example 1.

A summary of the test results of reflection intensity of all recording film layers of the present example indicates that the reflection intensity within the range of the wavelength of 300-900 nm is between 5-90%. Listed in Table 1 are the maximum reflection intensity and the minimum reflection intensity of all of the recording film layers of the present example at the recording light wavelength of 780 nm, 650 nm, and 400 nm. Judged by Table 1, the optical recording media of the present invention maintains a considerably high reflection intensity within the visible light region.

Table 1

Recording light wavelength (nm)	780	650	400
Maximum reflection intensity (%)	55	62	37
Minimum reflection intensity (%)	8	14	24

Shown in Table 2 is the arrangement and combination of the reflection intensity of all of the film /7

layer combinations of the present example at the light wavelength of 780 nm, 650 nm, and 400 nm, which can reach the maximum positive and reverse contrast ratio. Judged by Table 2, the light recording media of the present invention, whether it is equivalent to the existing optical disc modulation specifications or different from the existing optical disc modulation specification, always have considerable great contrast ratio with the visible light region (the positive contrast is the same as the existing optical disc modulation specifications or the reverse contrast contrary to the existing optical disc modulation specifications).

Table 2

Recording light wavelength (nm)	780	650	400
Positive contrast (%)	85	80	50
Reverse contrast (%)	-90	-100	-50

Example 4

The structure of the test film of Example 4 is as shown in Figures 1A and 1B, wherein the substrate 10 is polycarbonate, while the transparent layer 30 is silicon, which is sputtered over the substrate 10 at 300 W for 30 min. The reflecting layer 40 is gold silicon alloy which is sputtered over the transparent layer 30, wherein gold is sputtered at the power of 260 W, and silicon at 210 W. The sputtering time for the various film layers of the test film of the present example is the same as in the test film unit [sic] in Example 1.

The static test is the same as in Example 1, and Figure 5 is the photograph of the static test observation using an optical microscope. Judged by the observation of the test results, the semi-transparent reflecting zone 35 during the entire pulse duration with DC 21 mA and AC over 2V

undergoes a reaction wherein the reflection intensity decreases. In the case of AC 2V, the size of the semi-transparent reflecting zone 35 is always below 1.5 mm, and the contrast ratio before and after recording is between 51-70%; wherein the minimum area is below 1.5 mm (write-in pulse duration 10 ns) or so, and its contrast ratio before and after recording can reach 51%. In the case of AC 3V, the maximum contrast ratio of the semi-transparent reflecting zone 35 can reach 100%; wherein the recording spot of the semi-transparent reflecting zone 35 can be 2.0 M at the minimum.

<u>Example 5</u>

The structure of the test film of Example 5 is as shown in Figures 1A and 1B, wherein the substrate 10 is transparent glass, while the transparent layer 30 is indium tin oxide, around 50 nm thick. The reflecting layer 40 is tin which is sputtered over the transparent layer 30.

The static test is the same as in Example 1. Judged by the observation of the test results, the /8
semi-transparent reflecting zone 35 during the entire time when DC is 27 mA and AC over 1V has a reaction wherein the reflection intensity decreases. In the case of AC 2V, the size of the semi-transparent reflecting zone 35 is always below 1.5 mm, and the contrast ratio before and after recording is between 30-60%; wherein the minimum area is below 1.5 mm (write-in pulse duration 10 ns) or so, and its contrast ratio before and after recording can reach 48%. The maximum contrast ratio of the semi-transparent reflecting zone 35 in the case of AC 3 V can reach 60%.

Although the present invention has been disclosed above through a number of preferred embodiments, this disclosure does not restrict the present invention. Keeping the premise not to deviate from the spirit and range of the present invention, technical personnel in the field can change and modify it, therefore the range of protection of the present invention is to be determined by the attached claims.

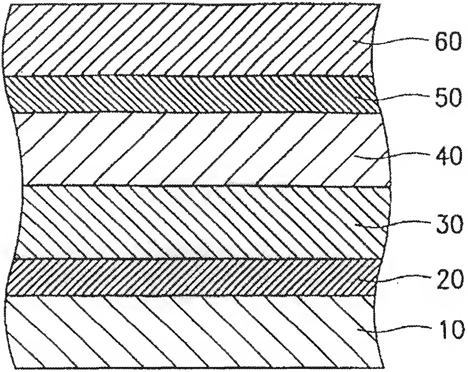

Figure 1A

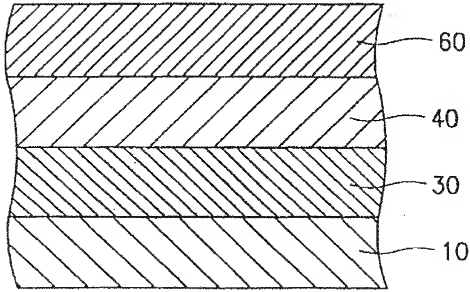

Figure 1B

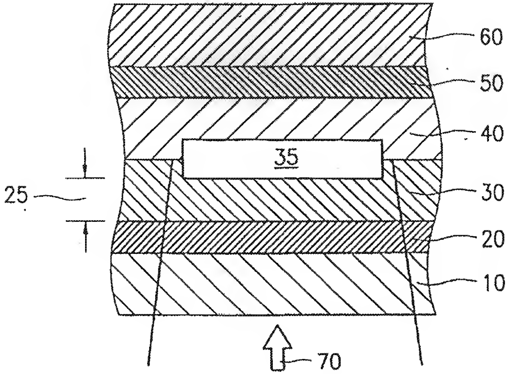

Figure 2A

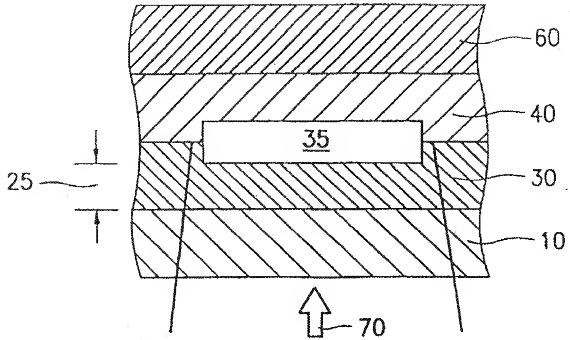

Figure 2B

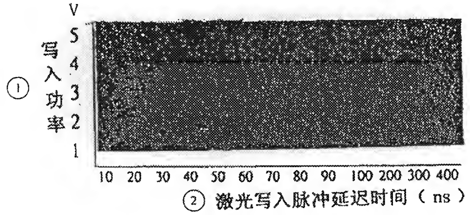

Figure 3

Key: 1 Write-in power

2 Laser write-in impulse delay time (ns)

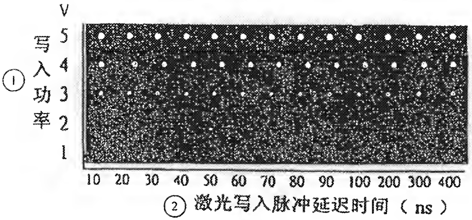

Figure 4

Key: 1 Write-in power

2 Laser write-in impulse delay time (ns)

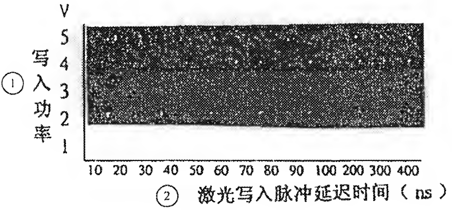

Figure 5

Key: 1 Write-in power

2 Laser write-in impulse delay time (ns)